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의견제출통지서

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주소 서울 강남구 대치3동 942 해성빌딩 11층

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발명의 명칭 액체 검출 압전장치, 액체 용기 및 장착 모듈

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[첨 부]
첨부1 인용문헌 1부 끝.

2003.09.30

특허청 심사2국

정밀기계심사담당관실 심사관 공인복

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<<안내>>

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⑲ 日本国特許庁 (JP)　　⑪ 特許出願公開

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㊹小形振動式レベル検出器

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㉑特 願 昭58—113070

㉒出 願 昭58(1983) 6月23日

明 細 書

1.発明の名称　小形振動式レベル検出器

2.特許請求の範囲

振動板(1)の裏面に加振用圧電素子(3)を定着し、該加振用圧電素子(3)に交流電圧を印加して振動板(1)を共振振動させ、該振動板(1)の表面に粉体、粒体、液体等が接触することにより生じる振動振幅の変化を振動電圧変換素子により電気信号に変換して粉体、粒体、液体等のレベル変化を検出する振動式レベル検出器において、振動板(1)に重錘(4)を附設して共振周波数を可変せしめるよう構成したことを特徴とする小形振動式レベル検出器。

3.発明の詳細な説明

(1) 発明の目的

本発明は、容器内における粉体、粒体、液体等のレベル変化を検出するための小形振動式レベル検出器に関するものである。

従来の振動式レベル検出器は、第1図に示すような構造であり、振動板1'が機械的共振点で振動した場合に最も効率よく粉体等の被検出物を感知することができる。

しかしながら、この種の従来の検出器において小形のものを製作するためには振動板1'を小径にしなければならず、振動板1'を小径にすれば固有共振周波数が高くなると共に振動振幅が減少することになり、そのため、共振点が可聴周波数帯域であれば非常に耳障りな音となる。そして振幅が減少すると検出感度が高くなり過ぎて作動が不安定になると共に外部の振動等による影響を受け易くなり、しかも振動板1'の検出面に付着する粉体や粘性液体を排除する力も弱まるので、誤作動の要因となる等種々の欠点が派生する。

共振周波数を下げる手段として、振動板1'の板厚を薄くしたり或いは弾性の低い材質を使用するのも一法であるが、強度の低下を伴なうことは免れ得ない。

共振周波数での駆動は外の方法を用いる場合の欠点として、振幅を大きくする場合は加振力を強める必要があり、また、耳障りな周波数の音の対

策としては、音量を下げるか或いは超音波領域を使用する方法があるが、前者は圧電磁器板の加振力の強いものを必要とすると共に検出感度が悪化するという欠点があり、後者は感度が高くなって不安定になり易い等の欠点がある。

本発明の目的は、上述のような従来の欠点を払拭して、小径の振動板であっても作動の安定性に優れ且つ耳障りな音の発しない小形のレベル検出器を、低価格に提供することにある。

(2) 発明の構成

本発明に係る小形振動式レベル検出器においては、振動板の裏面に加振用圧電素子に交流電圧を印加して振動板を共振振動させ、該振動板の表面に粉体、粒体、液体等が接触することにより生じる振動振幅の変化を振動電圧変換素子により電気信号に変換して粉体、粒体、液体等のレベル変化を検出する振動式レベル検出器において、振動板に重錘を附設して共振周波数を可変せしめるよう構成したことを特徴としている。

以下実施例の図面について説明すると、1は振動板であって、現状フレーム2の内端縁部に被着せられ、表面には圧電磁気板等の加振用圧電素子3が所定の配設態様により貼着される。3'は振動電圧変換素子である。4は円柱状の重錘であって、振動板1の中心部にビス止め或いは溶接等により(または一体成型により振動板1の中心部に凸設されてもよい。)定着される。5a，5b，5cは電極であって、現状フレーム2内において夫々振動板1，加振用圧電素子3，振動電圧変換素子3'と接続される。

6は被検出物の供給される容器であり、本発明検出器の使用時には振動板1の表面を容器6内へ向けて、現状フレーム2のフランジ部2fが容器6の外壁面へ当接するように取付ける。

容器6内には粉体、粒体、液体等の被検出物7が供給されるが、加振用圧電素子3に交流電圧を印加して振動板1を共振振動させると、該振動板1の表面に被検出物7が接触することにより振動振幅の変化が生じるので、この振動振幅の変化を振動電圧変換素子3'により電気信号に変換して容器1内における被検出物7のレベル変化を検出するのであるが、振動板1の中心部には重錘4が定着されているので、前記共振振動の周波数は低減せしめられることになる。この低減率は、重錘4の重量を加減することによって任意の値に設定し得るのである。

(3) 発明の効果

本発明検出器では、振動板1の中心部に共振周波数を低くするための重錘4が附設せられているので、次のような効果が派生する。

第一に、低減周波数で加振させた場合、従来の振動板と同等の駆動力で加振するよりも大きな振幅の振動が得られる。従って、容器6内における被検出物7の上限検出用として使用した場合に、振動板1の検出面の附着物(粉体や粘性液体)を排除することが容易であるという利点がある。また、振動音の聴感に対する効果として、300Hz以下の周波数の音であれば、長時間でも或る程度耐えられる程度に振動音が緩和されるという実験結果が得られた。

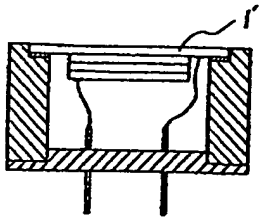
第二に、共振周波数での駆動時には、従来よりも少ない駆動力で効率の良い振動が得られ、粉体や液体を高感度に検出し得るという利点がある。そして加振用圧電素子3として、圧電磁気板の加振力の弱いものでも使用できるので、低コストに製造し得られ、また、駆動電圧を低くできるので、維持費を低減せしめ得るという利点もある。

4.図面の簡単な説明

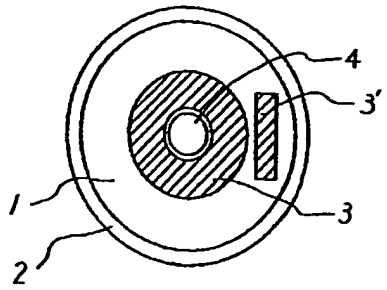
第1図は従来の振動式レベル検出器の縦断面図である。第2図は本発明検出器の縦断面図、第3図は第2図のA－A線における横断面図である。~~第4図の(A)(B)(C)は本発明検出器における振動板の縦断面形状を例示したものである。~~第4図の〔A〕〔B〕〔C〕〔D〕は本発明検出器における振動板への重錘の附設態様を例示した側面図、第5図の〔A〕〔B〕は本発明検出器における加振用圧電素子と振動電圧変換素子との配設態様を例示した振動板の裏面図である。第6図は本発明検出器の使用時の取付状態を例示した縦断面図である。

1…振動板，3…加振用圧電素子，
3'…振動電圧変換素子，4…重錘。

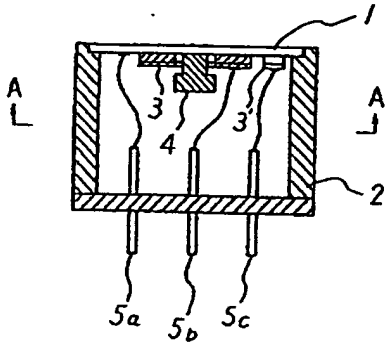
第1図



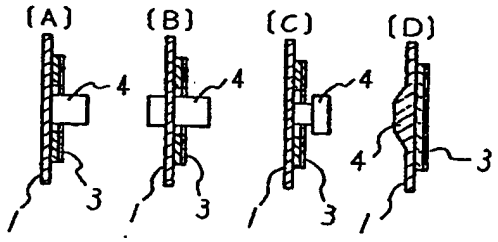
第3図



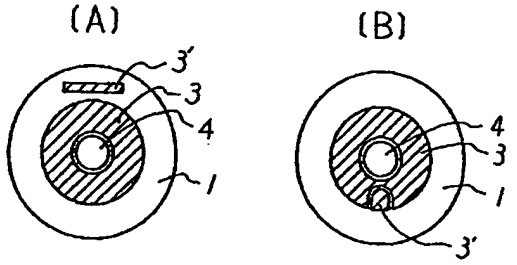
第2図



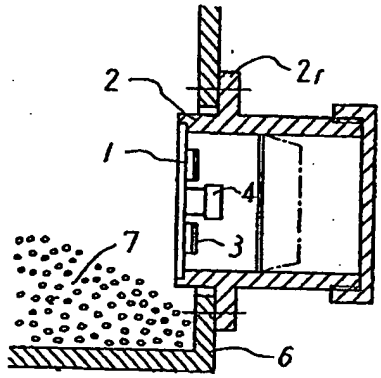
第4図



第5図



第6図



Japanese Patent Application Publication No. Sho. 60-4820
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Filed: June 23, 1983

SPECIFICATION

1. TITLE OF THE INVENTION

Small Sized Vibration Type Level Detector

2. CLAIMS

A small sized vibration type level detector for detecting a level change of a powder, grain, liquid or the like by fixing a vibrating piezo-electric element (3) on a back surface of a vibrating plate (1), vibrating said vibrating plate (1) in resonance while alternating current voltage is applied to said vibrating piezo-electric element (3) and converting a change in vibration amplitude resulting from contact of said powder, grain, liquid or the like onto a front surface of said vibrating plate (1) into an electric signal with a vibro-voltage conversion element, wherein a resonant frequency is changeable by adding a weight (4) to said vibrating plate (1).

3. DETAILED DESCRIPTION OF THE INVENTION

(1) Objects of the Invention

The present invention relates to a small sized vibration type level detector for detecting a level change of a powder, grain, liquid or the like in a container.

A conventional small sized vibration type level detector, which has a structure shown in Fig. 1, can sense a material to be detected such a powder or the like efficiently in case a vibrating plate 1' vibrates with a

mechanical resonant point.

However, in order to manufacture this kind of conventional detector in a small size, it is necessary to make the vibrating plate 1' small, but making the vibrating plate 1' small causes that the natural resonant frequency becomes high and the vibration amplitude becomes reduced as well, and accordingly the resonant point is within the audio frequency band so that the sound gets annoying to hear. In addition, if the amplitude is decreased, the detection sensitivity is too high, so that the operation becomes unstable as well as liable to be affected by the external vibration or the like, and thus since the force to eliminate the powder or liquid of viscosity adhering onto the detection surface of the vibrating plate 1' becomes weakened, various defects causing false operations occur.

As a means to decrease the resonant frequency, there is a method in which the thickness of the plate of the vibrating plate 1' is thin or a material of low elasticity is used, but the reduction of the strength is inevitable in the method.

As a defect in a method except driving at the resonant frequency is used, it is necessary to strengthen the vibrating force in case of increasing the amplitude, and as a measure against the sound of frequency offensive to the ear, there is a way of decreasing the volume of sound or using the ultrasonic wave band, but the former has a defect necessary to strengthen the vibrating force of the piezo-electric ceramic plate and worsening the detection sensitivity as well, and the latter has a defect liable to become unstable because the sensitivity becomes high.

In order to solve the problems above, it is an object of the present invention to provide a small sized vibration

type level detector, wherein the stability of the operation is excellent and the sound offensive to the ear does not occur regardless of a small sized vibrating plate, at a low price.

(2) Configurations of the Invention

A small sized vibration type level detector relating to the present invention is configured to detect a level change of a powder, grain, liquid or the like by fixing a vibrating piezo-electric element on a back surface of a vibrating plate, vibrating the vibrating plate in resonance while an alternating current voltage is applied to the vibrating piezo-electric element and converting a change in vibration amplitude resulting from the contact of the powder, grain, liquid or the like onto a front surface of the vibrating plate into an electric signal with a vibro-voltage conversion element, wherein the resonant frequency can be changeable by adding a weight to the vibrating plate.

Hereinafter, the drawings in relation to exemplary embodiments will be described; 1, which is a vibrating plate, is fitted to an inner edge part of a circular frame 2, wherein a vibrating piezo-electric element 3 such as a piezo-electric ceramic plate is attached onto the back surface of the vibrating plate. 3' is a vibro-voltage conversion element. 4, which is a weight of a cylindrical shape, is fixed to a center part of the vibrating plate 1 with screws or by soldering. Alternatively, it may be provided to project on the center part of the vibrating plate 1 by integral molding. 5a, 5b and 5c, which are electrodes, are coupled to the vibrating plate 1, the vibrating piezo-electric element 3 and the vibro-voltage conversion element 3' respectively in the circular frame 2.

6 is a container by which the material to be detected is supplied, and the front surface of the vibrating plate 1 is attached toward the inside of the container 6 during the use of the detector of the present invention in order that a flange part 2f of the circular frame 2 comes into contact with an outer wall surface of the container 6.

The container is supplied with the material to be detected 7 such as a powder, grain, liquid or the like, and when the vibrating plate 1 is vibrated in resonance by applying alternating current voltage to the vibrating piezo-electric element 3, the change in the vibration amplitude occurs because the material to be detected 7 is in contact with the front surface of the vibrating plate 1, and thus the level change of the material to be detected 7 is detected in the container 1 by converting the change in the vibration amplitude into the electric signals by the vibro-voltage conversion element 3', and the frequency of the vibration in resonance is decreased because the weight is fixed to the center part of the vibrating plate 1. The decrease rate can be set freely by increasing or decreasing the heaviness of the weight 4.

(3) Advantages of the Invention

According to the detector of the present invention, since the weight 4 is added to the center part of the vibrating plate 1 for decreasing the resonant frequency, the following effects are achieved:

Firstly, in case of exciting with a low frequency, the vibration of great amplitude can be obtained even by exciting with the same driving force as the conventional vibrating plate. Therefore, when using it for detecting an upper limit of the material to be detected in the container

6, there is an advantage that it is easy to eliminate the attached material (a powder or liquid of viscosity) on the detection surface of the vibrating plate 1. And, as an effect in audibility for the vibration sound, an experimental result that it is alleviated to some extent endurable even for a long time can be obtained.

Secondly, when driving with the resonant frequency, the vibration of great efficiency can be obtained with the driving force less than the conventional one, and thus there is an advantage that a powder or liquid can be detected with high sensibility. And, since even a piezo-electric ceramic plate of weak vibrating force can be used as the vibrating piezo-electric element 3, it can be manufactured at a low cost and the driving force can be lowered, and thus there is an advantage that a cost can be reduced.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertically cross-sectional view of a conventional vibration type level detector, Fig. 2 is a vertically cross-sectional view of a detector of the present invention, and Fig. 3 is a horizontal cross-sectional view in regard to A-A line Fig. 2. [A], [B], [C] and [D] of Fig. 4 are side views that show an example of a state in which a weight is attached to the vibrating plate in the detector of the present invention, and [A] and [B] of Fig. 5 are rear views of the vibrating plate that show an example of arrangement of a vibrating piezo-electric element and a vibro-voltage conversion element. Fig. 6 is a cross-sectional view that shows an attached state of the detector of the present invention when it is used.